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I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003906049 for a patent by LEONARD FRANCIS BEYERS as filed on 31 October 2003.

WITNESS my hand this
Eleventh day of November 2004

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MANAGER EXAMINATION SUPPORT
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AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: **Method and apparatus for laying reinforcing bars**

The invention is described in the following statement:

Method and Apparatus for Laying Reinforcing Bars

Field of the invention

The present invention relates to a method and an apparatus for assembling reinforcement. The present invention particularly relates to a method and apparatus for assembling and laying reinforcement, especially reinforcement used in the construction of roads, most especially reinforced concrete roads.

Background of the invention

Reinforced concrete roads conventionally comprise a foundation layer, the so-called sub-base, usually of un-reinforced concrete, and the pavement or so-called base slab, which is reinforced, and is poured directly onto the sub-base.

Typically, the base slab is reinforced by a rectangular grid of steel reinforcing rods comprising a plurality of spaced apart longitudinal rods extending in the direction of the road and a plurality of spaced apart transverse rods extending athwart the longitudinal rods and tied thereto at each crossing point in the mesh. The longitudinal rods are individually fairly short, say 12 metres long, but successive longitudinal rods are spliced together, that is to say, overlapped and tied to each other, to form a continuous ribbon of mesh extending along the road. That ribbon is supported from the sub-base by plastic or other bar chairs to ensure that the reinforcing is at the correct altitude in the finished pavement.

Hitherto, the mesh ribbon has been formed in-situ by a gang of steel fixers by hand. This not only involves manhandling all the steel into place and tying the individual rods together while stooped over double, but also requires the preparatory steps of marking the edge of the pavement on the base-base with a chalk line and spot marking the location of the individual transverse rods with paint to ensure that the fixers install the reinforcement to specification. The work is laborious and time consuming. Typically a gang of twelve workers can put the reinforcement in place for 200 to 250 metres of two lane pavement per day.

In my Australian patent no. 752 385, the entire contents of which are herein incorporated by way of cross-reference, I describe a mobile workstation for assembling and laying of pavement reinforcing bars. The mobile workstation has a wheeled chassis adapted to travel a route along which the pavement is to be laid. The mobile workstation carries longitudinal guide and spacing means that is positioned to receive longitudinal reinforcing rods and to space the longitudinal reinforcing rods apart from each other in a transverse direction. The mobile workstation also includes an open topped magazine for holding a quantity of transverse reinforcing rods. In use, the longitudinal reinforcing rods are positioned in the longitudinal rod guide and spacing means and travel over the open-topped magazine. The transverse rods in the open topped magazine are connected one at a time to the longitudinal rods to form a reinforcing mesh. The reinforcing mesh then slides over an apron at the rear of the mobile workstation and the mesh is deposited behind the chassis as the chassis moves ahead.

The mobile workstation described in my Australian patent no. 752 385 has resulted in increases in production of between 60% and 100% when compared with conventional methods for laying and typing pavement reinforcement.

Another recent development in laying and assembling reinforcing involves the use of BAMTEC technology. This technology connects a number of reinforcing bars together by welding each bar to flexible steel straps at desired spacing. The thus-connected bars are then rolled up into rolls. When it is time to install the reinforcing, the rolls of reinforcing bars are placed at an appropriate position and simply unrolled. Thus, installation is very quick. Moreover, the spacing and the thickness of the reinforcing rods can be determined for each application using appropriate design criteria and the reinforcing rolls utilising the required rod thickness and spacing can be pre-assembled at a factory for subsequent delivery to the site. BAMTEC is a registered trade marks of Bam AG

Summary of the invention

In a first aspect, the present invention provides a method for assembling and laying reinforcement including the steps of providing a mobile workstation for assembling and laying the reinforcement, said mobile workstation being moveable across

a surface, arranging a plurality of longitudinal reinforcing rods in spaced relationship, providing a roll comprising a plurality of reinforcing rods connected together by flexible connecting elements, positioning the roll on the mobile workstation such that the plurality of reinforcing rods of the roll are positioned transversally to the longitudinal reinforcing rods, moving the longitudinal reinforcing rods rearwardly relative to the mobile workstation, joining one of the transverse reinforcing rods of the roll to one or more of the longitudinal reinforcing rods as the longitudinal reinforcing rods move relatively rearwardly past the roll, and unwinding the roll as the longitudinal reinforcing rods continue to move relatively rearwardly past the roll, connecting further of the transverse reinforcing rods to one or more of the longitudinal reinforcing rods to form a mesh of reinforcing rods, and depositing the mesh on the surface behind the mobile workstation.

Preferably, the longitudinal reinforcing rods are provided in the form of a roll of rods connected together by flexible connecting elements and the longitudinal rods are arranged in spaced relationship by unrolling the roll.

The longitudinal rods are suitably supported on a support means located to the fore of the roll of transverse reinforcing rods.

In one embodiment, the longitudinal reinforcing rods are moved rearwardly relative to the mobile workstation by moving the mobile workstation in a forward direction whilst keeping the horizontal position of the longitudinal rods generally fixed relative to the surface on which the mobile workstation travels. In this fashion, the reinforcing mesh that has been laid on the surface behind the mobile workstation remains in place. As the workstation moves forward, further reinforcing mesh is deposited upon the surface. Thus, the reinforcing mesh grows in the forward direction of travel of the mobile workstation.

In a most suitable embodiment of the first aspect of the present invention, the roll of transverse reinforcing rods is caused to unwind by one or more of the transverse reinforcing rods of the roll being connected to the one or more longitudinal reinforcing rods. As will be understood by the person skilled in the art, the relative rearwards movement of the longitudinal reinforcing rods results in the roll of transverse reinforcing

rods to unroll or unwind due to the connection between the transverse rods and the longitudinal reinforcing rods.

It will be appreciated that the longitudinal reinforcing rods have a certain length. As the longitudinal reinforcing rods move rearwardly relative to the mobile workstation, it may become necessary to connect further longitudinal reinforcing rods to the longitudinal reinforcing rods moving rearwardly relative to the mobile workstation, especially if a continuous mesh of reinforcement is to be obtained. To achieve this, once the substantial length of a set of longitudinal reinforcing rods has been used to be connected to the transverse reinforcing rods, another set of longitudinal reinforcing rods is arranged such that the ends of the first set of longitudinal reinforcing rods can be joined to ends of the second longitudinal reinforcing rods, for example by welding or tying. This ensures that the longitudinal extent of the reinforcing mesh can be extended without forming a break in the longitudinal extent of the reinforcing mesh.

It is preferred that the longitudinal reinforcing rods and the transverse reinforcing rods are connected by welding. Welding may be affected by use of welding apparatus operated by welding operators. Alternatively, automatically welding apparatus may be used. However, the present invention also extends to other methods of connecting the longitudinal rods to the transverse rods, such as tying.

The method of the present invention is particularly suitable for assembling and laying reinforcement for use in reinforced concrete roads.

In a number of instances, it is preferred that the reinforcing mesh be deposited on the surface in a fashion such that the reinforcing mesh is held above the surface. In this manner, the reinforcing mesh can be completely encased by concrete. To achieve this, it is possible to position the reinforcing mesh onto support members that hold the reinforcing mesh above the surface. The support members may suitably be bar chairs or other spacers that sit upon the surface.

The present invention also extends to encompass a mobile workstation for assembling and laying reinforcement.

Accordingly, in a second aspect, the present invention provides a mobile workstation for assembling and laying reinforcement including longitudinal reinforcement rod support means for supporting a plurality of longitudinal reinforcing rods in spaced relationship to each other, roll holding means for holding at least one roll comprising a plurality of transverse reinforcing rods connected together by one or more flexible connecting elements, wherein use a plurality of longitudinal reinforcing rods are positioned in spaced relationship to each other on the longitudinal reinforcing rod support means and the plurality of longitudinal reinforcing rods travel rearwardly relative to the mobile workstation such that the longitudinal reinforcing rods move past the roll holding means wherein a transverse reinforcing rod is connected to one or more of the longitudinal reinforcing rods and the roll unwinds and further of the transverse reinforcing rods are connected to one or more of the longitudinal reinforcing rods to form a mesh of reinforcing rods and the mesh is deposited onto a surface behind the moveable workstation.

The mobile workstation preferably includes a chassis that is moveable across a surface. The chassis is suitably a wheeled chassis for ease of movement on the surface. The wheel chassis may also be provided with cterpillar tracks, if appropriate.

The longitudinal reinforcement rod support means may include an apron means extending rearwardly of roll holding means. The apron means suitably includes a portion that extends rearwardly and downwardly towards the surface onto which the reinforcing mesh is deposited.

The longitudinal reinforcement rod holding means may further include a longitudinal rod support means located to the fore of the roll holding means. The longitudinal reinforcement rod support means may, for example, comprise a tray that forms part of the mobile workstation. Alternatively, this part of the longitudinal reinforcement rod support means may comprise a tray of a support vehicle, such as a truck, that is used in conjunction with the mobile workstation.

The roll holding means suitably includes one or more cradles.

The roll holding means are preferably positioned below a path of travel of the longitudinal reinforcing rods as the longitudinal reinforcing rods move rearwardly relative to the mobile workstation. However, it will be appreciated that the roll holding means may also be positioned such that the roll holding means are above the path of travel of the longitudinal reinforcing rods.

The roll holding means may include one or more rotatable elements on which the roll is supported, said one or more rotatable elements facilitating unrolling of the rolls. The one or more rotatable elements may comprise one or more wheels or rollers.

As mentioned earlier, the roll holding means suitably include one or more cradles. The one or more cradles are preferably semi-circular in shape. The one or more cradles may extend across the mobile work station. Alternatively, a number of narrow cradles may be positioned transverse relative to each other to support each roll.

Brief description of the drawings

Figure 1 shows a plan view of plurality of reinforcing rods connected together by flexible steel straps;

Figure 2 shows a side view of the reinforcing rods Figure 1;

Figure 3 shows a side view of a mobile work station in accordance with the present invention;

Figure 4 is an expanded view of the inset A shown in Figure 3;

Figure 5 is a plan view of the mobile work station shown in Figure 3;

Figure 6 is a side view, in cross-section, showing an alternative cradle arrangement for use with the mobile workstation of Figures 3-5;

Figure 7 is a plan view showing the apparatus of figures 3-6 with a mobile gantry in position; and

Figure 8 is a side view of the mobile gantry shown in Figure 7.

Detailed description of the drawings

It will be appreciated that the drawings attached in this specification are provided for the purpose of illustrating preferred embodiments of the present invention. It is to be understood that the invention should not be considered to be limited to the features described and disclosed in those drawings.

Figure 1 shows a plan view of a plurality of reinforcing rods that are connected together by flexible steel straps. The plurality of reinforcing rods 10, 12, 14, 16, 18 are laid out such that they are generally parallel to each other and overlay a plurality of flexible steel straps 20, 22, 24. The reinforcing rods are tack welded to the flexible steel straps at the points where the two intersect. This is conveniently shown in Figure 2 where the build up of weld metal 26 can be seen.

The reinforcing rods and flexible connecting straps shown in Figures 1 and 2 can be wound up or rolled up into rolls for ease of transport and handling. Such rolls are commercially available and sold under the BAMTEC Trademark. BAMTEC is a registered trademark of Bam AG.

A mobile work station in accordance with the second aspect of the present invention will now be described with reference to Figures 3, 4 and 5. In these Figures, the mobile work station 30 has a chassis 32 that carries a number of wheels 34. The front wheels may be free-swivelling castor wheels. The rear wheels may also swivel, but they may be held at any selected swivel angles, for example, by means of trailing links extending from the wheel axis to a steering rod. In this regard, the wheels may be arranged in the same fashion as described in my Australian Patent Number 752385.

The chassis may comprise a steel frame having appropriate longitudinal members and transverse members. Again, the chassis may be as described with reference to my Australian Patent Number 752385. The chassis also includes a central tow hitch 36 to enable the mobile work station 30 to be towed behind a truck 38. Thus, the mobile work station shown in Figures 3 to 5 is in the form of a towable trailer. However, it will be appreciated that the mobile work station of the present invention may also be in the form of a self-driving apparatus.

The chassis 32 carries three cradles 40, 42, 44. As shown in Figure 4, cradle 42 includes a semi-circular trough 46 having a concave upper side. The semi-circular trough 46 extends substantially across the entire width of the mobile work station 30. In order to stably mount the semi-circular trough 46 to the chassis 32, appropriate brackets 48, 50 are mounted to the chassis 32 and brackets 48, 50 support the semi-circular trough 46. It will be appreciated that brackets 48, 50 may extend across the width of the mobile work station 30. Alternatively, a plurality of transversely spaced brackets 48, 50 may be mounted to the chassis 32 of the mobile work station 30 in order to support the cradle 42.

The mobile work station further includes an apron 52. The apron 52 comprises a support surface that may include a plurality of longitudinal members and cross members connected together. The apron 52 is supported from the chassis 32 by posts 54, 56, 58. As can be seen from Figure 3, posts 54, 56, 58 are of varying length and are sized such that the rear-most part of the apron slopes downwardly towards the ground.

The forward part of the apron 52 includes a down turned edge 60 that provides a guide for the reinforcing rods. This will be described in more detail hereunder.

The truck 38 has a tray 62 that is sized to support a plurality of longitudinal reinforcing rods. These reinforcing rods may be separate rods that are not connected to each other. In this case, the mobile work station preferably includes a longitudinal rod guide and spacing means, as described with reference to the mobile work station described in my Australian Patent Number 752385. Alternatively, and preferably, the longitudinal rods may be connected to each other by a plurality of flexible steel straps. In these regard, the longitudinal rods may be as described with reference to Figures 1 and 2. Most suitably, the longitudinal rods are supplied in the form of a roll of reinforcing rods. This will be described in more detail hereunder.

The mobile work station further includes a guide means 64 positioned in front of the cradles 40, 42, 44. Guide means 64 has a downwardly turned deflecting lip 66. The guide means 64 is supported on a post 68 connected to chassis 32. Guide means 64 is used to ensure that the longitudinal rods that are passing rearwardly relative to the mobile work station pass over the cradles 40, 42, 44.

Operation of the mobile work station shown in Figures 3 to 5 will now be described. This will also explain preferred embodiments of the method in accordance with the first aspect of the present invention.

In order to operate the mobile work station 30 in accordance with the present invention, a roll 70 of reinforcing rods is placed in cradle 44. Similarly, rolls 72, 74 are placed in respect of cradles 42, 40. As can be seen from Figure 5, rolls 70, 72, 74 are positioned such that the reinforcing rods lay transverse to the direction of travel of the mobile work station. The direction of travel of the mobile work station is shown by arrow 76 in Figure 5.

At start up, a roll of transverse rods is unrolled such that it effectively covers the entirety of the apron 52 and extends a short distance past the rear end of the apron 52. A roll of longitudinal bars is then positioned over the rear most portion of the transverse bars. The row of longitudinal bars is then unrolled. The longitudinal reinforcing rods and transverse reinforcing rods are then tack welded together as a number of points to form a reinforcing mesh.

With reference to Figure 5, at start up roll 70 of transverse rods is unrolled such that a mat of transverse rods 78 connected to each other by flexible steel straps (in the fashion as shown with reference to Figures 1 and 2) extends over the apron and past the rear edge of the apron. A first roll 80 of longitudinal rods is positioned as shown in Figure 5 and unrolled such that the longitudinal rods 82 extends substantially across the width of the transverse rods 78. In Figure 5, only three longitudinal rods 82 are shown for the sake of clarity. The transverse rods 78 are then tack welded to one or more of the longitudinal rods 82.

As can be seen from Figure 5, longitudinal rod 82 have a length of approximately half the length of the apron 52. Therefore, longitudinal rod 82 terminate in the area shown by reference numeral 84. In order to assemble an essentially continuous reinforcing mesh, a second roll 86 of longitudinal rods is positioned such that one end of the longitudinal bars in roll 86 extends into area 84 such that the ends of longitudinal rods from roll 86 overlaps with the end of longitudinal rods 82. The area of overlap of the rods from the first roll of longitudinal rods 80 and the second row of longitudinal rods 86 may

be joined together, for example by welding. The welding is preferably in the form of a lap joint. However, a butt joint may also be used. It will be appreciated that the second roll of longitudinal rods 86 is positioned and unrolled such that the longitudinal rods 86 extend across the length of the transverse rods 78 before the longitudinal rods in roll 86 are welded to the longitudinal rods 82.

As can be seen from figure 5, the longitudinal rods from second roll 86 are sufficiently long such that a terminate in the area designated by reference numeral 88. In order to maintain an essentially continuous mesh of reinforcement, a further roll 90 of longitudinal rods is positioned on the tray 62 of the truck 38. Again, connection between the longitudinal rods of roll 86 and the longitudinal rods 92 of roll 90 is achieved by means of an overlap welded joint or a butt welded joint.

Once the reinforcing mesh is formed by tack welding of the transverse rods 78 to the longitudinal bars 80 or 86, the reinforcing mesh 94 extends beyond the rear most portion 96 of apron 52. As the truck 38 moves forward in the direction of travel 76, the reinforcing mesh 94 is deposited onto spacers or chairs 98 that sit on a subsurface slab 100 of pavement under construction. It will be appreciated that subsurface slab 100 represents the surface on which the mobile workstation travels.

As the truck slowly advances forward, the reinforcing mesh 94 is slowly deposited on the spacers or chairs 98. It will be appreciated that there is effectively no horizontal movement between the subsurface slab 100 and the longitudinal rods 82, 86, 92. However, as the mobile workstation 30 is moving in a forwardly direction, the longitudinal rods are effectively moving rearwardly relative to the mobile workstation. Once some of the transverse rods 78 have been tack welded to the longitudinal rods 82, the relatively rearwardly travel of the longitudinal rods relative to the mobile workstation 30 causes the roll 70 of transverse rods to unroll. Consequently, further transverse bars 78 become available for tack welding to the longitudinal rods in order to create further reinforcing mesh.

When the roll 70 of transverse rods has been exhausted, the second roll 72 of transverse rods is then used to be joined to the longitudinal rods that pass above it. Similarly, when second roll 72 of transverse rods is exhausted, third roll 74 of transverse

rods is then used to join transverse rods to the longitudinal rods to continue making the reinforcing mesh.

Whilst this is taking place, cradles 42 and 44 may be supplied with fresh rolls of transverse reinforcing rods.

Once the start-up phase is completed, welding of the longitudinal rods to the transverse rods will typically take place in welding zone 92 (see figure 3).

The tack welding between the longitudinal rods and transverse rods may be achieved by welding operators standing on or sitting above the mobile workstation 30. To this end, a platform or seating means may be provided on the mobile workstation 30. The platform or seating means may be supported by posts extending out from the lateral edges of the chassis 32. Alternatively, automated welding stations may be provided on the mobile workstation in order to form the tack welds between the longitudinal bars and transverse bars.

In an alternative embodiment shown in Figures 7 and 8, the apparatus is provided with a mobile gantry that can move across the region where welding takes place in order to allow the welding of the longitudinal and transverse rods. The mobile gantry may be used to support a gang of welders, in which case the welding is a manual welding operation. Alternatively, the mobile gantry may support one or more automatic welding heads.

In figures 7 and 8, features that are common with figures 3-6 are denoted by like reference numerals.

The apparatus of figures 7 and 8 includes a mobile gantry 130. The mobile gantry 130 includes respective side modules 132, 134.Side module 134 is shown in more detail in figure 8. It comprises a side member 136 carrying wheels 138, 140. Wheels 138, 140 run along rail146 mounted to the side of the apparatus 30. Other side module 132 has a similar arrangement of wheels running along a similar rail 146a mounted to the other side of the apparatus 30.

Transverse members 142, 144 extend upwardly from side member 136 of side module 134 and across the width of the apparatus 30 to the other side module 132.

Transverse members 142,144 are positioned above the longitudinal and transverse rods during use of the apparatus. Transverse members 142, 144 support a plurality of movable seats 148, 150, 152, 154, 156, 158. Figure 8 shows that seat 158 has wheels160, 162 attached thereto by downwardly extending brackets164, 166. Wheels 164, 166 can run on transverse members 142, 144, thus allowing seat 158 to move from side-to-side. Although figure 8 shows only 2 wheels attached to seat 158, it will be appreciated that more wheels, especially 4 wheels, may be attached to seat 158. The other seats have a similar arrangement.

Thus, the mobile gantry allows welders to sit on the seats and to adjust their transverse and longitudinal position to allow welding in zone 92 and also in zone 94, which is the lap welding zone.

The mobile gantry may be provided with a motor to facilitate longitudinal movement of the gantry along rails 146, 146a. The mobile gantry may also be provided with automatic welding heads in place of the movable seats.

The method and apparatus of the present invention has a number of advantages over the apparatus and method described in my Australian Patent No. 752385. In particular, use of a roll of transverse rods connected to each other by flexible steel straps allows the roll of transverse rods to be unrolled or unwound once one or more of the transverse rods have been tack welded to the longitudinal rods. Accordingly, the roll of transverse rods unwinds at a rate that is governed by the rate of travel of the mobile workstation. The downturned lip 60 at the forward end of apron 52 ensures that the transverse rods 78 and their associated steel straps are guided onto the upper surface of the apron 52. Thus, the mat of transverse rods and connecting steel straps is automatically positioned onto the top surface of the apron such that tack welding to the longitudinal rods can be easily achieved. It is not necessary for operators to lift a large number of transverse rods into position for tack welding to the longitudinal rods, as was the case with the mobile workstation described in Australian Patent No. 752385.

As a further advantage, the cradles that hold the roll of transverse rods can be easily refilled with fresh rolls.

It is also preferred that the longitudinal rods are provided in the form of a roll of rods that is unrolled on the tray 62 of the truck 38. This enables rapid placement of the longitudinal rods onto the tray 62 of truck 38. It also can obviate the need for use of the longitudinal guiding and spacing means that is used on the mobile workstation described in Australian Patent No. 752385.

The method and apparatus of the present invention allows for increased productivity in the preparation of reinforcing meshes. The meshes can be quickly assembled and placed onto a surface.

In an alternative construction for the cradles, as shown in figure 6, a cradle 110 includes a semi-circular trough member 112 fitted with four rotatable wheels or rollers 114, 116, 118, 120. The roll 122 of transverse rods rests upon the rotatable wheels or rollers 114, 116, 118, 120. Consequently, the unrolling of roll 122 is facilitated and enhanced.

It will be understood that the invention disclosed and defined herein extends to all alternative combinations of two or more of the individual features mentioned or evident from the text or drawings. All of these different combinations constitute various alternative aspects of the invention.

The foregoing describes embodiments of the present invention and modifications, obvious to those skilled in the art can be made thereto, without departing from the scope of the present invention.

Dated this 31st day of October 2003

Leonard Beyers

by its attorneys

Freehills Carter Smith Beadle

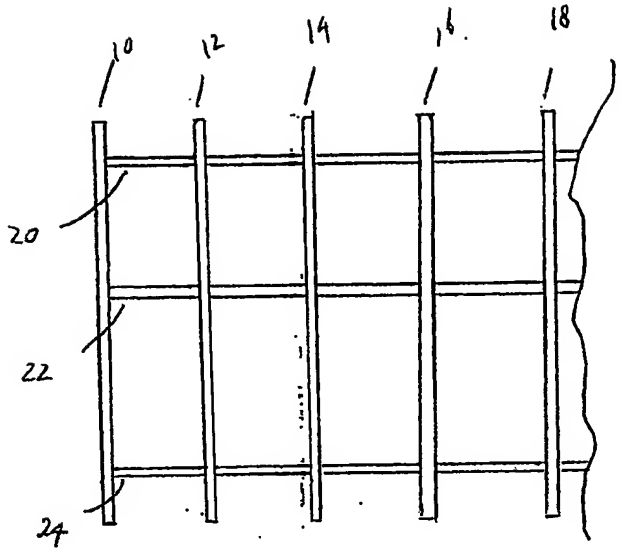

FIGURE 1

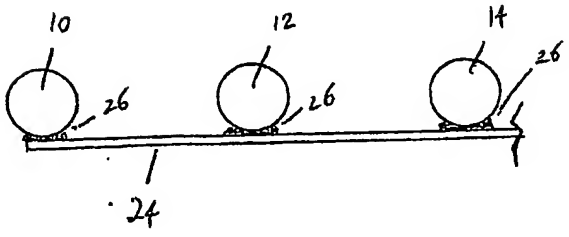

FIGURE 2

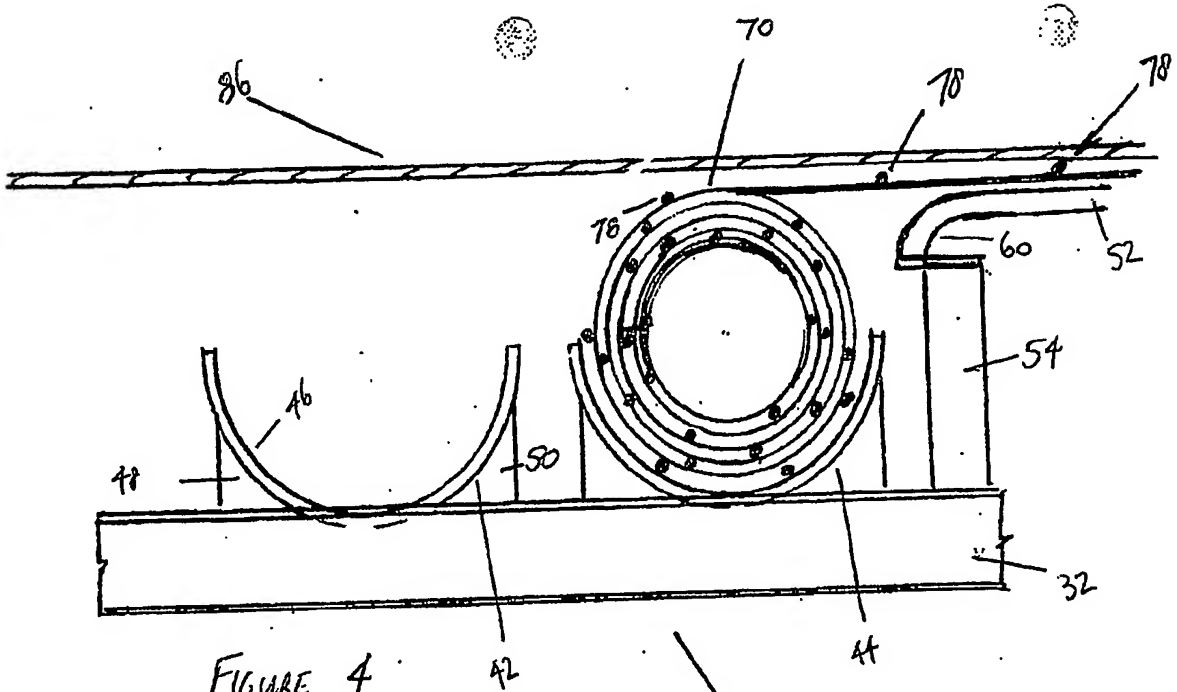

FIGURE 4

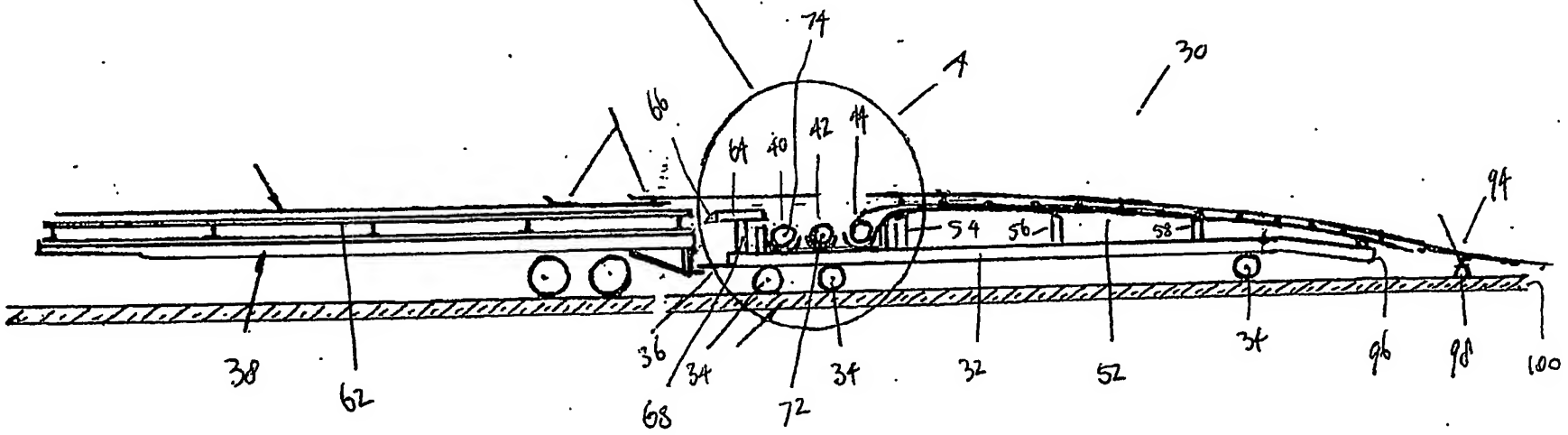

FIGURE 3

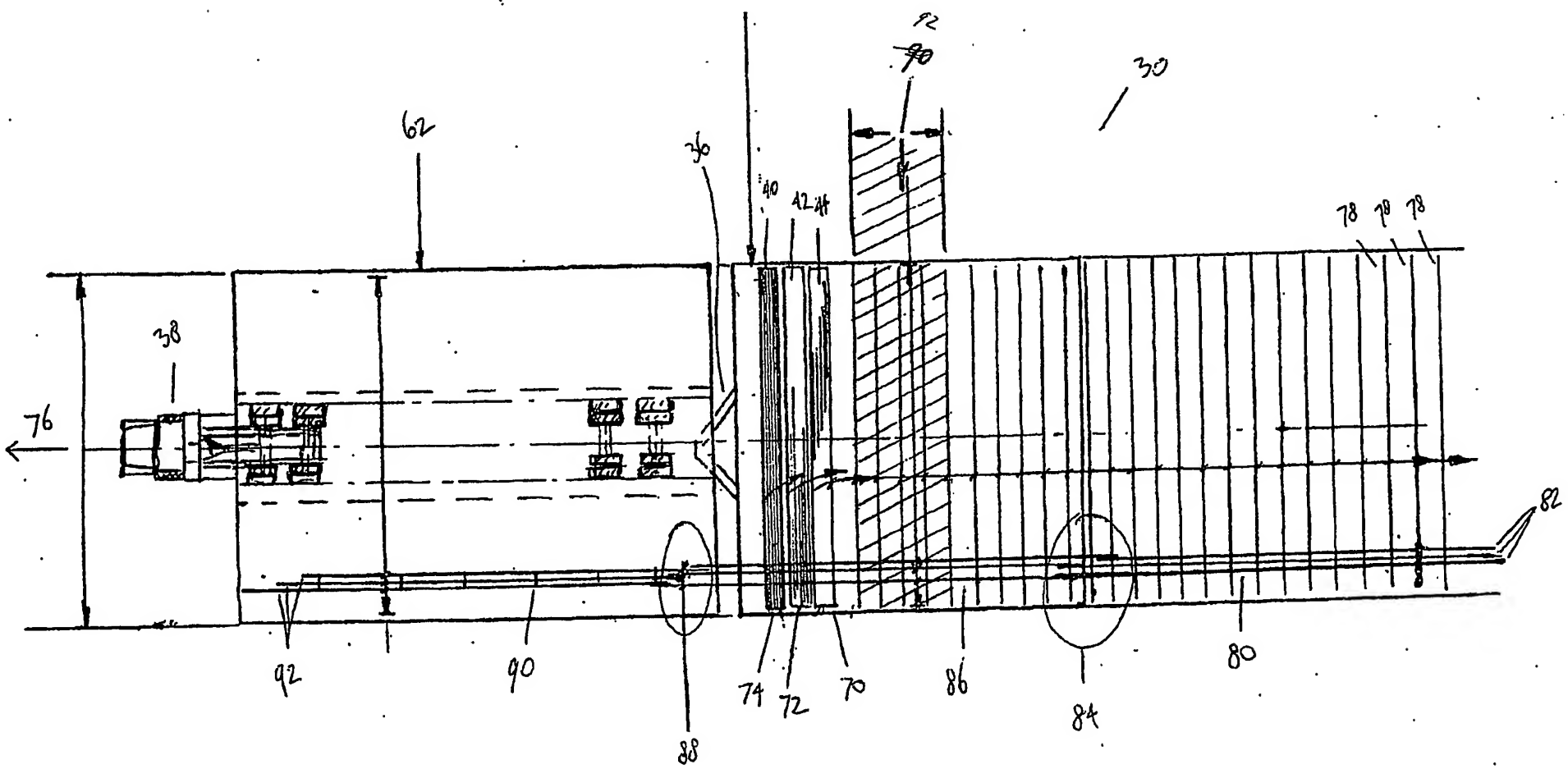

FIGURE 5.

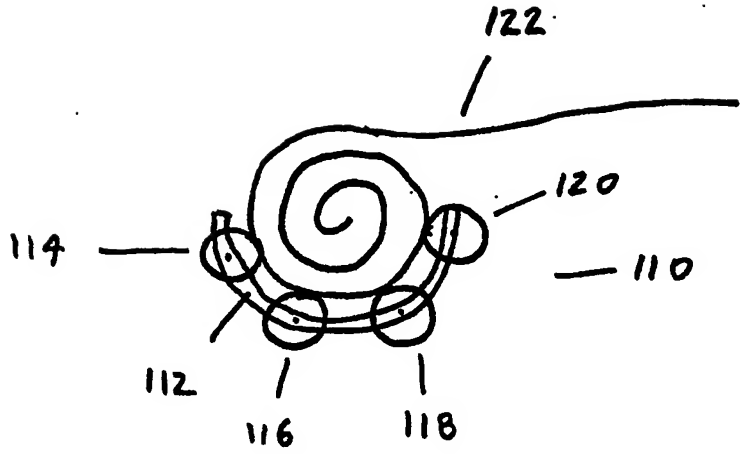

FIGURE 6.

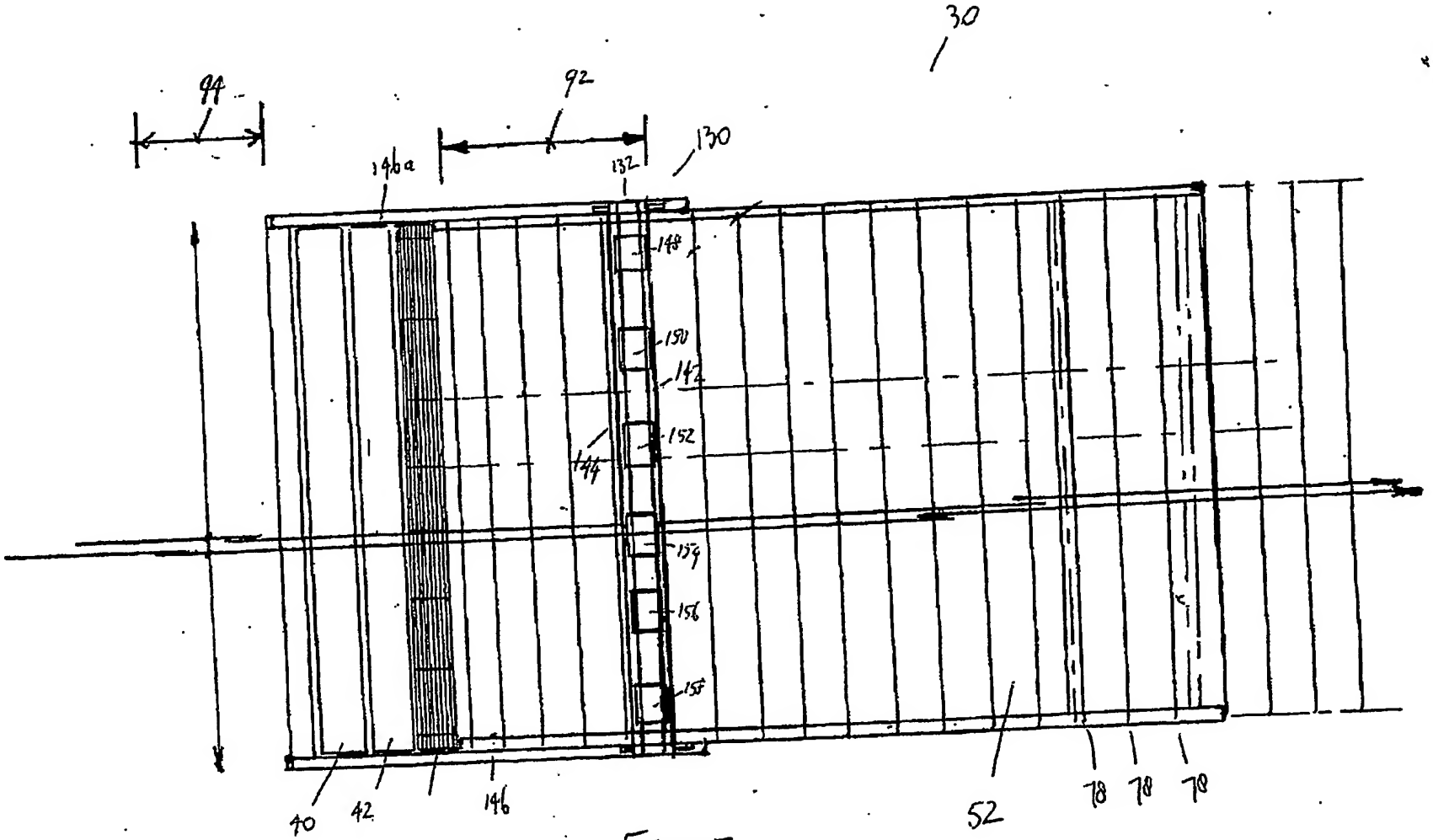

FIGURE 7

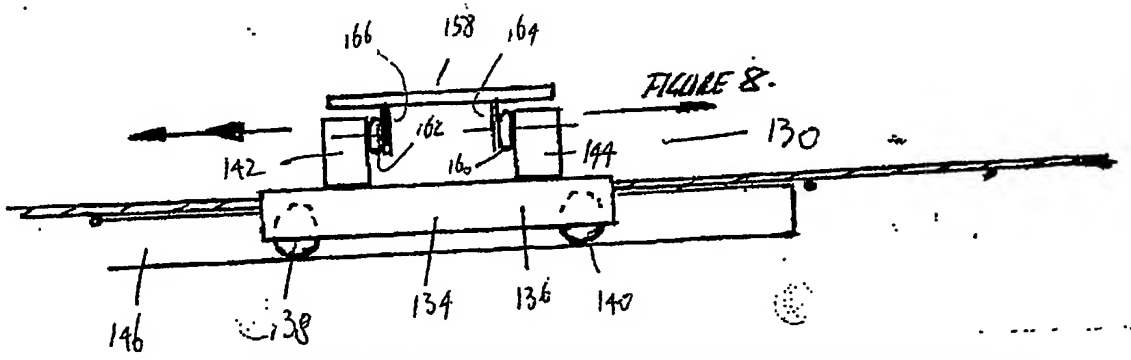

FIGURE 8.

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